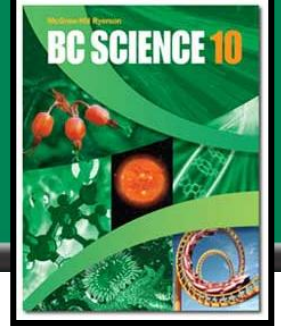
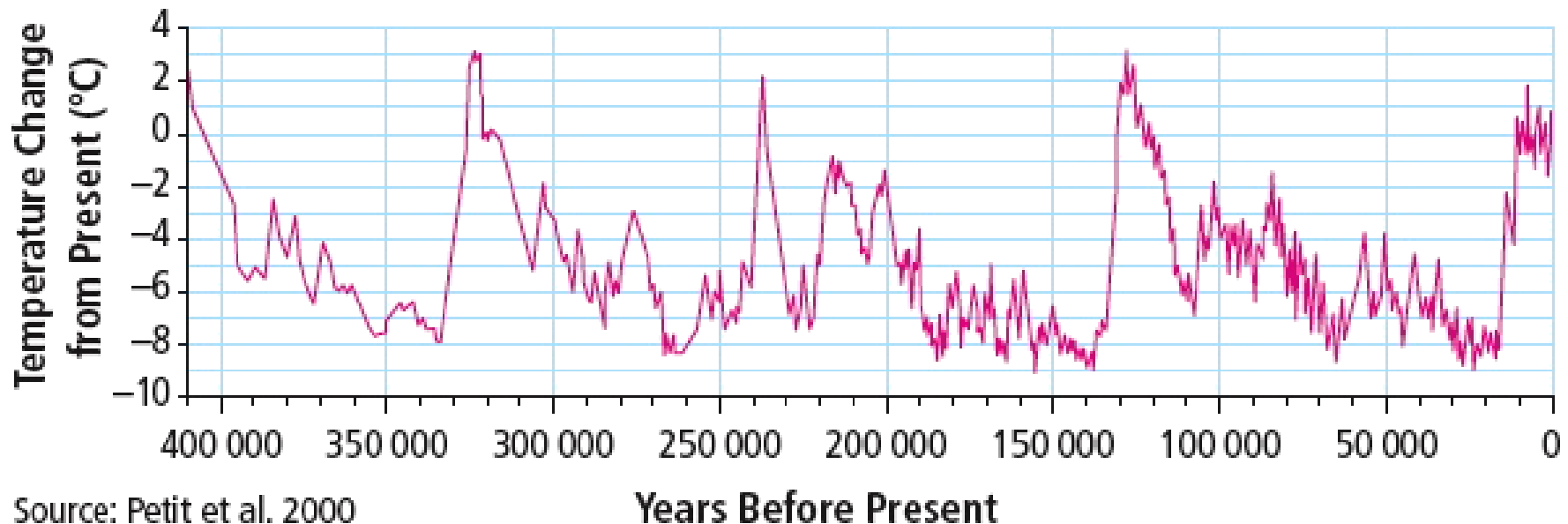


11.2 Human Activity and Climate Change



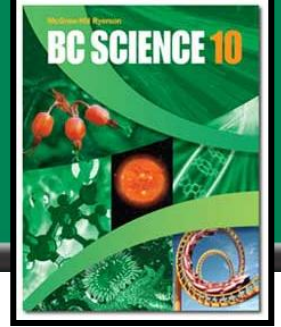
- Climate change - change in **long-term weather patterns in certain regions.**
- Global warming refers to a global increase in average **temperature.**

Change in Global Temperature Over Time



See pages 482 - 483

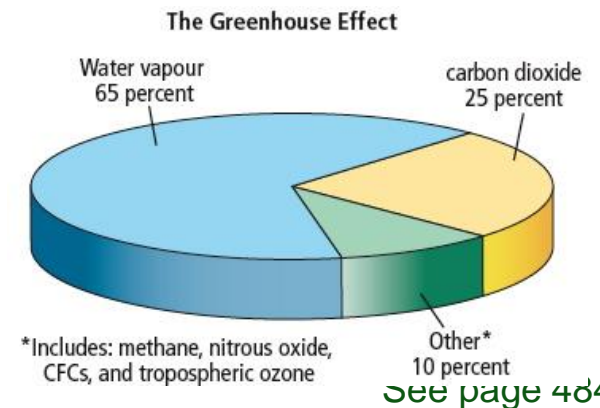
The Enhanced Greenhouse Effect



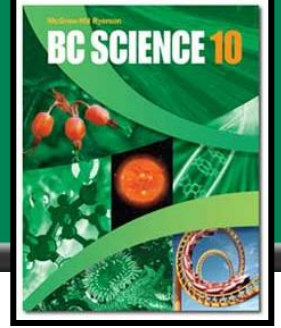
- Enhanced greenhouse effect increases thermal energy absorbed.
- More greenhouse gases in atmosphere = increase of natural greenhouse effect
- Greenhouse gases: **water vapour, CO₂, methane, nitrous oxide, and CFCs.**
- Global warming potential (GWP)** – ability of chemical to trap thermal energy. (CO₂ is given a GWP of 1; CFCs are 4750-5310)

Table 11.1 Greenhouse Gases and Global Warming Potential

Greenhouse Gas	Chemical Formula	Atmospheric Lifetime (years)	Source from Human Activity	Global Warming Potential (GWP)
carbon dioxide	CO ₂	variable	<ul style="list-style-type: none"> combustion of fossil fuels deforestation 	1
methane	CH ₄	about 12	<ul style="list-style-type: none"> processing of fossil fuels livestock agriculture waste dumps rice paddies 	25
nitrous oxide	N ₂ O	114	<ul style="list-style-type: none"> production of chemical fertilizers burning waste industrial processes 	298
chlorofluorocarbons (CFCs)	various	45	<ul style="list-style-type: none"> liquid coolants refrigeration air conditioning 	4750–5310



The Enhanced Greenhouse Effect: Carbon Dioxide and Methane



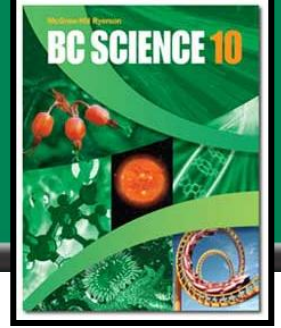
- CO_2 levels have increased greatly in past 200 years.
 - ◆ use of **fossil fuels**
 - ◆ Deforestation
- Methane is very efficient at trapping thermal energy (25X more efficient than CO_2)
 - ◆ Produced by bacteria breaking down wastes in oxygen-free environments, animals digesting plant matter, rice paddies (and other natural wetlands), and burning of fossil fuels.



Livestock produce
18 percent of the
total methane in
the atmosphere.

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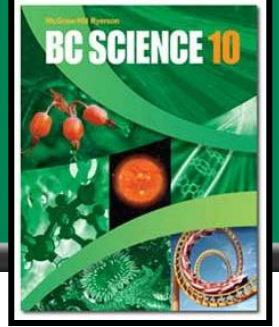
The Enhanced Greenhouse Effect: Nitrous Oxide, Ozone, and Halocarbons



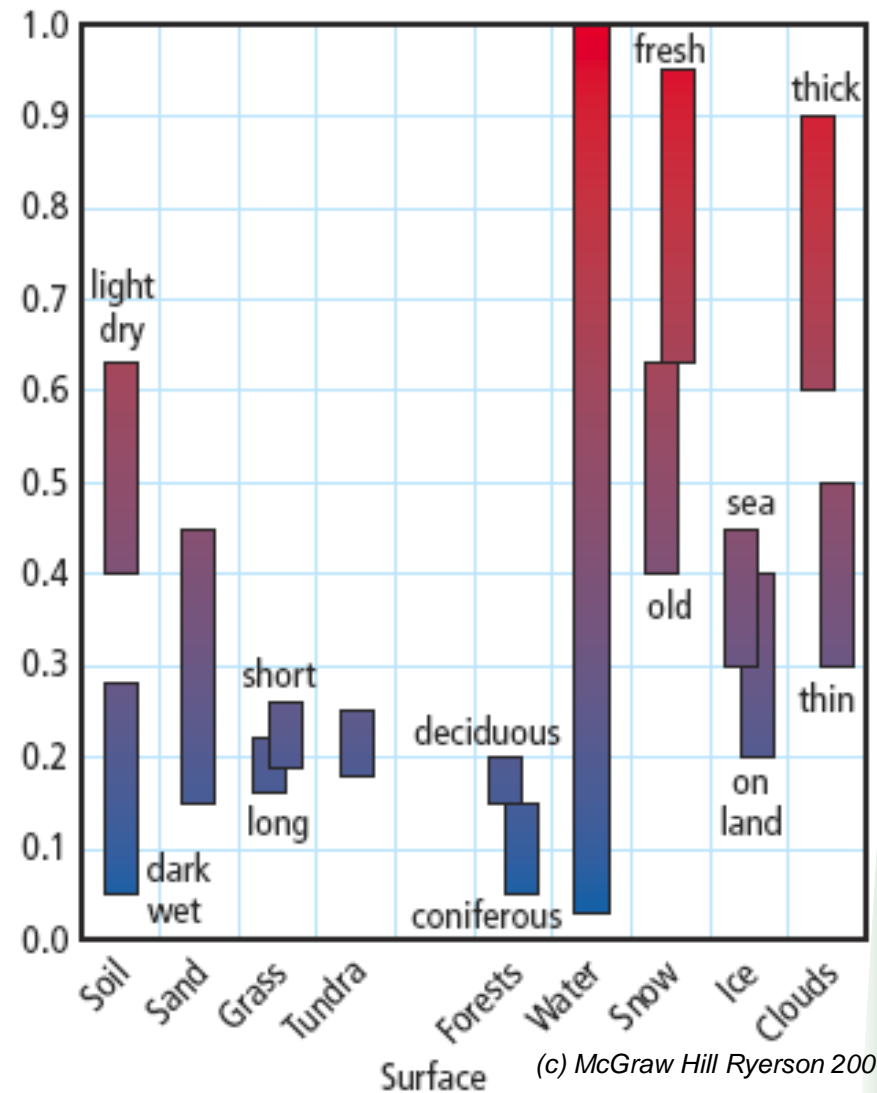
- Nitrous oxide, N_2O
 - ◆ 300X more GWP than CO_2 .
 - ◆ N_2O comes from bacteria, **fertilizers**, and improper disposal of human and animal waste.
- Ozone (greenhouse gas at lower elevations)
 - ◆ Chemical reaction between **sunlight and air pollution** from the burning of fossil fuels
- Halocarbons, used as refrigerants
 - ◆ **Chlorofluorocarbons (CFCs)**
 - ◆ Main reason for ozone layer depletion.

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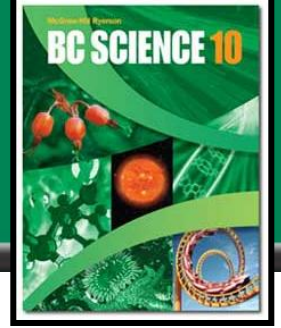
Albedo and Climate, Making Predictions About Climate Change



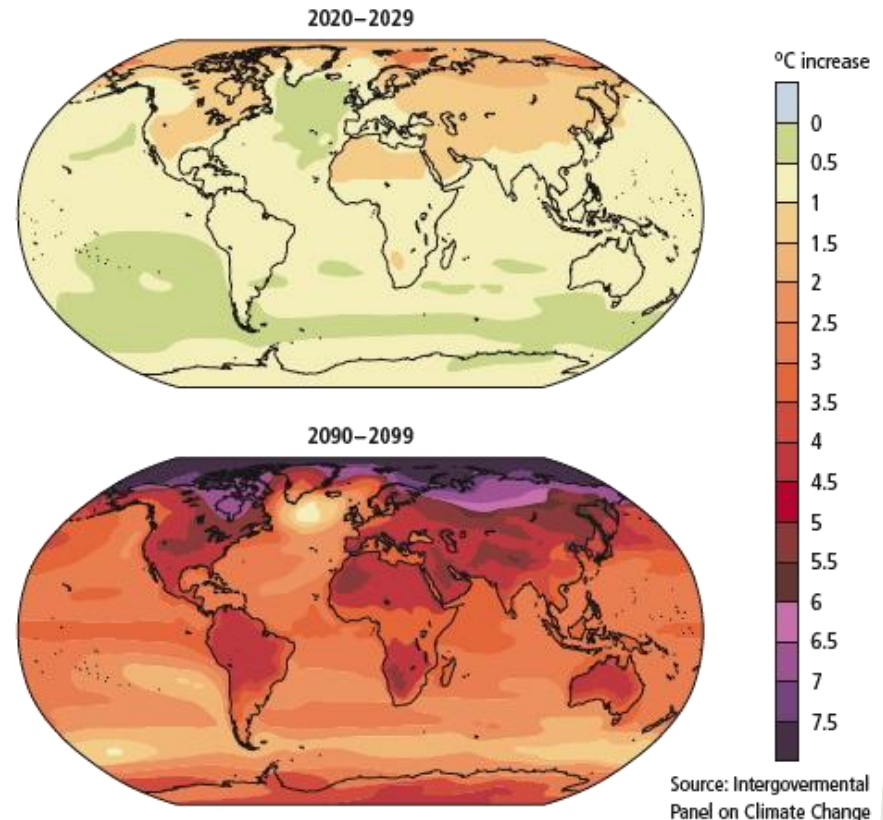
- **Albedo** at Earth's surface affects the amount of **solar radiation** that region receives.
- Changes in a region's albedo may result in climate change.



The Role of Science in Understanding Climate Change



- **General circulation models (GCMs)**
 - ◆ Computer models used to study climate.
 - ◆ Consider changes in greenhouse gases, albedo, ocean currents, winds and surface temperatures.
 - ◆ Used for weather **forecasting**, climate analysis, and climate change **predictions**.



Global Impacts of Climate Change

Main Fisheries Affected

- changes in the food supply that will affect international trade

Water Conflicts

- changes to precipitation patterns, causing the demand for water to surpass the supply

Greater Disease Risk

- the occurrence of diseases, such as malaria and other tropical diseases, farther north

Sea-Level Rise

- the loss of coastal land due to rising sea levels
- the potential for flood damage to low-lying coastal areas
- the mass movement of people fleeing the worst-affected areas

Deforestation

- an increase in the risk of forest fires due to a drying climate



Increased Severity and Frequency of Tropical Storms

- the mass movement of people fleeing the worst-affected areas

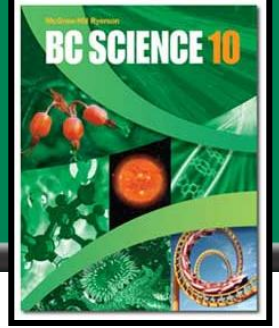
Decreasing Crop Yields

- changes in agriculture and the food supply that will affect international trade

Figure 11.27 This map shows how climate change could potentially affect all nations of the world.

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Impacts of Climate Change on Canada



- **Parts of Canada have had average temperature increases of 0.5°C to 1.5°C.**
 - ◆ **Arctic regions are losing permafrost and Arctic Ocean ice cover.**
 - ◆ **Heavier spring rains and severe droughts**
 - **Fisheries**
 - **Forestry**
 - **Health issues.**
 - ◆ **Sea levels will rise, and fresh drinking water may be harder to find as glaciers disappear.**

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Impacts of Climate Change on Canada

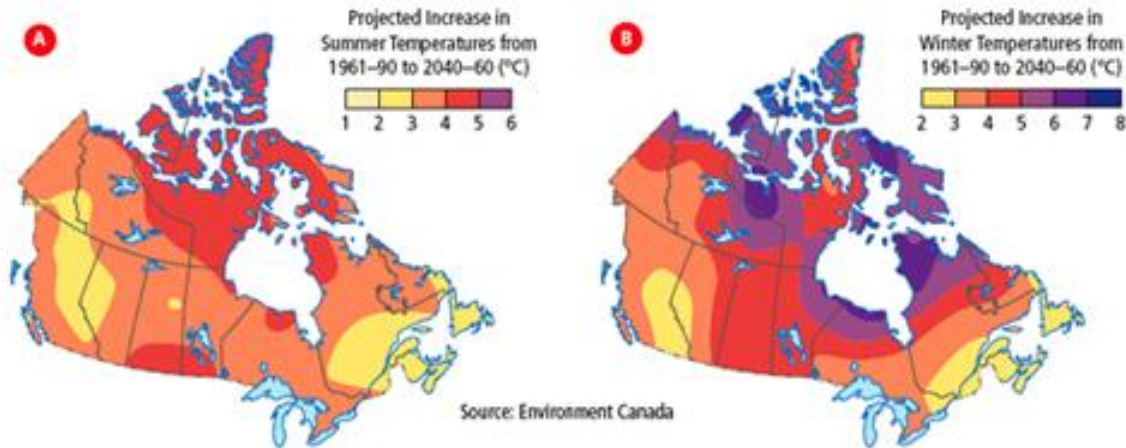
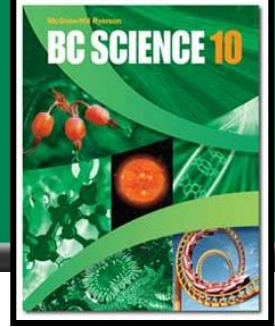


Figure 11.25 Projected temperature change for Canada in 2050, summer (A). Projected temperature change for Canada in 2050, winter (B). The maps are based on the Coupled Global Climate Model developed by Environment Canada.

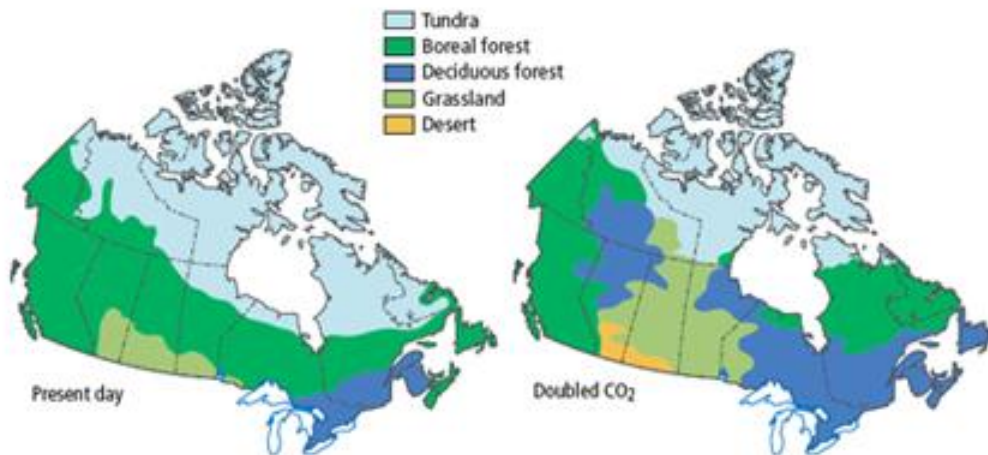


Figure 11.26 Changes projected for Canada's biomes if the concentration of CO_2 doubles from what it was before the Industrial Revolution.

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(c) McGraw Hill Ryerson 2007

Impacts of Climate Change on BC

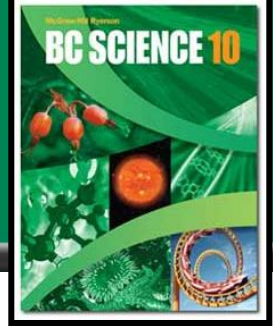
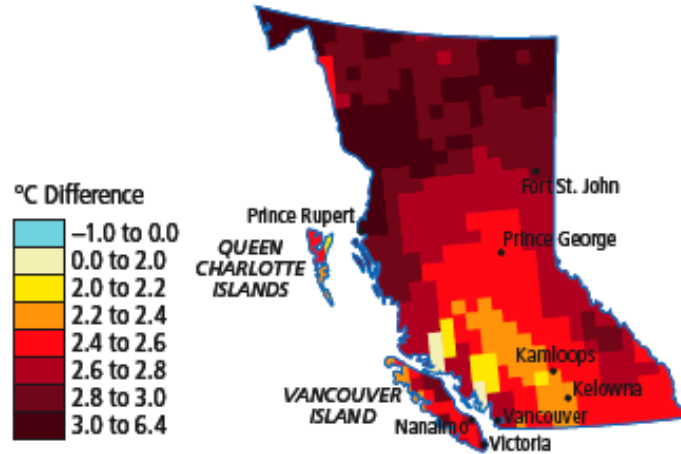
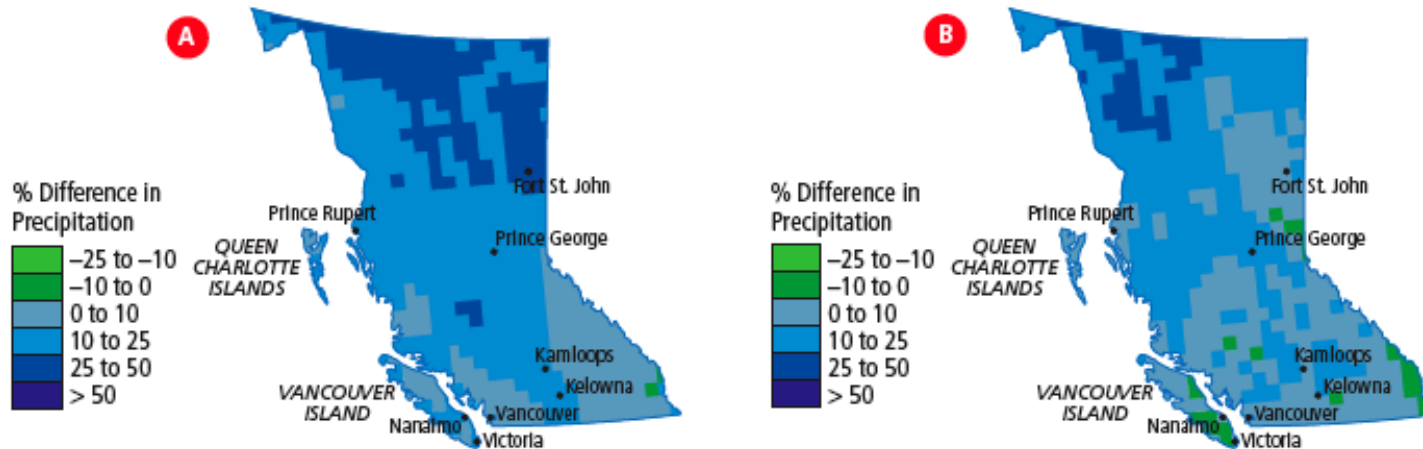


Figure 11.27 The projected change in average annual temperatures in British Columbia for 2041–2070 from historical temperatures.



Source: Adapted from Rodenhuis et al. 2007



Source: Adapted from Rodenhuis et al. 2007

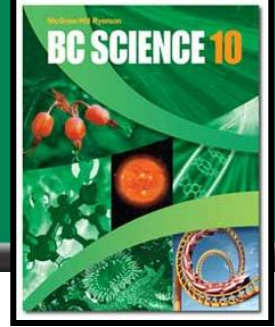
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Effects of Climate Change on British Columbia

Table 11.2 Predicted Effects of Climate Change on British Columbia

Segment Affected	Effects of Climate Change
Fisheries	<ul style="list-style-type: none"> • Changes in ocean life could occur; for example, warm water species, such as tuna and mackerel, may replace cold water species, such as salmon. • Salmon may migrate northwards to find colder water.
Forestry	<ul style="list-style-type: none"> • Northern regions will become warmer, extending the range of some tree species. • Droughts will affect many species of trees and favour the spread of grasslands. • Drought will increase the risk of fire in the forests. • Incidence of disease and insect infestations will increase.

Effects of Climate Change on British Columbia



Wetlands	<ul style="list-style-type: none">• Current flood-prevention measures may not be able to contain floods along the coast and in interior British Columbia.• Ecosystems in wetlands, estuaries, and deltas will be affected by a rise in water levels.
Water	<ul style="list-style-type: none">• A change in weather patterns will affect the supply and, therefore, the demand for water.• Spring thaws will arrive earlier, and droughts will happen more often and last longer.• Rising sea levels could mean saltwater flooding of low-lying farming areas.
Wildlife	<ul style="list-style-type: none">• Changing temperatures will alter habitats, food supplies, and shelter for many species of wildlife.• An increase in the amount of CO₂ dissolved in the ocean will make ocean water more acidic, which could harm ocean life and even result in the loss of some species.

Uncertainty and Decision, An Action Plan for the Global Community

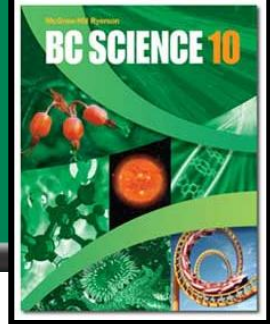









Table 11.5 Strategies for Addressing Climate Change

Sector	Strategy for Reduction of Greenhouse Gas Emission
Industry 	<ul style="list-style-type: none"> • switch to more energy-efficient electric equipment, heat, and power sources • increase the amount of recycling • monitor and control non-CO₂ gas emissions
Energy 	<ul style="list-style-type: none"> • develop more efficient ways of producing energy • research renewable energy sources (hydro-electric, wind, solar, biofuels, and geothermal power) • store CO₂ underground after it is removed from natural gas
Transportation 	<ul style="list-style-type: none"> • improve fuel efficiency for vehicles • introduce hybrid vehicles, which do not rely on fossil fuels alone • introduce alternate fuels, such as hydrogen or biofuels • shift from road transport to rail • improve and promote the use of public transportation
Construction 	<ul style="list-style-type: none"> • switch to high-efficiency lighting • use energy-efficient appliances, heating systems, and air conditioning systems • improve insulation of buildings • use solar and geothermal heating and cooling
Agriculture 	<ul style="list-style-type: none"> • improve fertilizer (nitrogen) use • specify crops used for energy purposes (i.e. corn, soybeans) • increased use of soil carbon storage • improve management of livestock waste • improve techniques for cultivating rice crops • reclaim and reuse lands damaged by agriculture
Forestry 	<ul style="list-style-type: none"> • promote world-wide planting of trees and re-forestation • encourage efficient use of forest products for energy • encourage better forest-management strategies
Waste Management 	<ul style="list-style-type: none"> • promote recycling, composting, and minimizing waste • encourage the burning of waste for energy recovery • recover methane gas from decomposition in garbage dumps and landfills

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